URSI AP-RASC 2019, New Delhi, India, 09 - 15 March 2019

Pre-seismic irregular ionosphere and its effect on the Total Electron Content and Scintillations as observed from Kolkata during Nepal Earthquake on 12 May 2015

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The pre-seismic anomalous condition in the ionosphere and the electromagnetic perturbations due to seismic activity have been known for a long time .Variations in ionospheric parameters above seismically active regions are one of most actual reasons of these perturbations. It is well established through many research papers that radon is considered as earthquake precursor. Anomalous soil radon (radon 222) fluctuations as a signal of Nepal earthquake in 12 May 2015 have been reported by Argha Deb and his group [1].According to them, radon anomalies on 29April 2015 were mainly observed 13 days prior to the M7.3 earthquake on 12 May in Kolkata, Jadavpur University. With reference to that our study has been made on total electron content (TEC) and carrier level fluctuations of GNSS satellite data taken with Septentrio receiver at the Institute of Radio Physics and Electronics, Calcutta University, Kolkata during April-May 2015. It is found that there is a good correspondence between the Radon emission, abnormal change in total electron content and some intense scintillation behaviour in the signal level of GNSS satellites.

Anomalous variations in GPS based TEC prior to earthquakes has been made by Fujiwara et al.[2] and Yadav et al.[3] and many others. When we have studied the data before and after 12 May 2015 earthquake and analysed the TEC found from Kolkata, it is found that on day 131 of 2015 (11 May 2015), the previous day of earthquake, TEC was considerably low during daytime and lies below the average TEC of all these days. But the nature is completely different during the night time, when the TEC is high compared to other days. It is also observed that on day 130 (10May 2015) and 119 (29 April 2015) the TEC during the morning hour is high, compared to the average value. There is no significant magnetic storm at that time so, that may be due to the radon emission before the earthquake due to which ionization is enhanced and the TEC show significantly high values compared to the average days.

While we have studied scintillations we have found that number of occurrence of scintillations begin to increase approximately two weeks before the main shock. On day 131, five satellites show carrier level fluctuations i.e. scintillations in low, moderate and high scale during post- sunset to post-midnight hours. Day 130 also shows mild to moderate level fluctuations in three satellites in pre-midnight hours. On the day 119, 13 day before earthquake, low to intense level fluctuations is found in six satellite during pre-midnight hours, which is quite unexpected in those non-equinoctial months . Along with that, the scintillations sometimes show about 10 to 30 minute intense patches during these days. Again, when we are watching the satellite tracks over our station, Kolkata, the satellites showing scintillations are not confined only in the southward regions from our stations, which is almost a regular fact for ordinary scintillation event. In the year 2015, the solar activity is not so high , so it can be inferred that these scintillations occurring due to ionization of the atmosphere arising due to radon exhalation from the ground due to earthquake.

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